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December 12, 2016
L-16-337

10 CFR 50.54(f)

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

SUBJECT:
Davis-Besse Nuclear Power Station
Docket No. 50-346, License No. NPF-3
Mitigating Strategies Assessment (MSA) for Flooding (TAC No. MF3721)

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued a letter titled, "Request for Information Pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," to all power reactor licensees and holders of construction permits in active or deferred status. Enclosure 2 of the 10 CFR 50.54(f) letter addresses Near-Term Task Force (NTTF) Recommendation 2.1 for flooding. One of the required responses is for licensees to submit a hazard reevaluation report (HRR) in accordance with the NRC's prioritization plan. By letter dated March 11, 2014, FirstEnergy Nuclear Operating Company (FENOC) submitted the flood HRR for Davis-Besse Nuclear Power Station (DBNPS). Additional information was provided by FENOC letters dated August 25, 2014, December 10, 2014, February 25, 2015, and August 11, 2015. As indicated in NRC letter dated March 1, 2013, the NRC staff considers the reevaluated flood hazard to be "beyond the current design/licensing basis of operating plants."

Concurrent to the flood hazard reevaluation, FENOC developed and implemented mitigating strategies in accordance with NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events." By letter dated September 1, 2015, the NRC staff confirmed that licensees need to address the reevaluated flooding hazards within their mitigating strategies for beyond-design-basis (BDB) external events. Guidance for performing mitigating strategies assessments (MSAs) for reevaluated flooding hazards is contained in Appendix G of Nuclear Energy Institute 12-06, Revision 2, which was endorsed by the NRC in JLD-ISG-2012-01, Revision 1. In the NRC interim staff assessment for DBNPS, dated September 3, 2015, the NRC concluded that the "reevaluated flood hazards information, as summarized in the Enclosure [Summary Tables of Reevaluated Flood Hazard Levels], is suitable for the assessment of mitigating strategies developed in response to Order EA-12-049" for DBNPS.

The enclosure to this letter provides the MSA for flooding for DBNPS. This assessment indicated that the FLEX strategy design basis did not bound the reevaluated flood hazard (that is, mitigating strategies flood hazard information) for the local intense precipitation (LIP) flood and the probable maximum storm surge (PMSS) flooding, which could challenge the successfully implementation of the FLEX strategy as designed. As a result, use of alternate staging areas and trigger points for pre-deployment of FLEX N+1 equipment are being developed. This will remove the challenges to the FLEX mitigating strategies from LIP and PMSS.

There are no new regulatory commitments contained in this letter. If there are any questions or if additional information is required, please contact Mr. Thomas A. Lentz, Manager – Fleet Licensing, at 330-315-6810.

I declare under penalty of perjury that the foregoing is true and correct. Executed on December 12, 2016.

Sincerely,

Brian D. Boles

Enclosure:
Mitigating Strategies Assessment for Flooding

cc: Director, Office of Nuclear Reactor Regulation (NRR)
NRC Region III Administrator
NRC Resident Inspector
NRR Project Manager
Utility Radiological Safety Board

## Mitigating Strategies Assessment for Flooding

**Acronyms:**

- BDBEE - Beyond Design Basis External Event
- DB - Davis-Besse Nuclear Power Station
- EFWF - Emergency Feedwater Facility
- FHRR - Flood Hazard Reevaluation Report
- FIP - Final Integrated Plan
- LIP - Local Intense Precipitation
- MSFHI - Mitigating Strategies Flood Hazard Information (from the FHRR and MSFHI letter)
- NORM - Nuclear Operating Reference Material
- NSRC - National SAFER Response Center
- PMSS - Probable Maximum Storm Surge
- PMWE - Probable Maximum Wind Event
- RAI - Request for Additional Information
- USAR – Updated Safety Analysis Report

**Definitions:**

**FLEX Design Basis Flood Hazard** - The controlling flood parameters used to develop the FLEX flood strategies.

**FLEX** - Diverse & Flexible Coping Strategies

- **Phase 1** - Initially cope by relying on installed plant equipment.
- **Phase 2** - Transition from installed plant equipment to the on-site FLEX equipment.
- **Phase 3** - Obtain additional capability and redundancy from off-site equipment until power, water, and coolant injection systems are restored or commissioned.

**FLEX N Equipment** - Equipment used is protected from all BDBEE hazards and is the primary FLEX response equipment.

**FLEX N+1 Equipment** - Equipment used is NOT protected from all BDBEE hazards and is used as an alternate to FLEX N equipment.

**FLEX NSRC Equipment** - Equipment provided by the NSRC to support FLEX Phase 3 strategy.

**Unit abbreviations**:

ft – feet
in – inches
psf – pounds per square foot
fps – feet per second

## 1. Summary

The Mitigating Strategy Flood Hazard Information (MSFHI) provided in the Davis-Besse Flood Hazard Reevaluation Report (FHRR) (Ref. 1) has concluded that the Local Intense Precipitation (LIP) and Probable Maximum Storm Surge (PMSS) can challenge implementation of the FLEX strategies. The existing FLEX strategies for these events can be modified to address the impacts of the MSFHI. Other reevaluated flood hazard mechanisms (i.e. tsunami, channel migrations/ diversions, etc.), are bounded by the plant design basis and have no impact on the site.

The MSFHI LIP flooding levels develop a depth above critical door sills for a limited period of time. Doors are closed in inclement weather based on existing plant procedures. As stated in references 1, 2 and 3 no internal flooding will be experienced that could jeopardize either safety-related or FLEX equipment. Sufficient margin exists in the FLEX strategies to allow for water recession around the power block thereby preventing a challenge to Phase 1 and Phase 2 FLEX strategies. FLEX N+1 and NSRC equipment are affected by the LIP standing water in the deployment routes. Phase 3 strategies rely on NSRC equipment. Alternate staging areas have been confirmed to be available during and after a LIP event, which will allow implementation of all phases of the FLEX strategies. Trigger points will be developed to allow for pre-deployment of N+1 equipment. Use of alternate staging areas and pre-deployment of N+1 equipment will remove challenges to the FLEX mitigation strategy from the LIP.

Similar to the LIP the MSFHI PMSS affects critical station doors for a short period of time. These impacts and their mitigation are the same as described above. The PMSS flood duration above 585 ft. in the power block area is 2.5 hours. Sufficient margin exist in the FLEX strategy to delay implementation until flood levels drop below 585 ft. The total above grade flood duration is six hours, but the depth and velocities allow for FLEX actions and deployment to be completed during this minor flooding. The PMSS also impacts NSRC site staging area and N+1 equipment deployment due to standing water. The depth and duration of the standing water is greater than the LIP effects. Alternate staging areas have been confirmed to be available, which will allow implementation of all phases of the FLEX strategies (Ref. 5). Trigger points will be developed to allow for pre-deployment of N+1 equipment. Use of alternate staging areas and pre-deployment of N+1 equipment will remove challenges to the FLEX mitigation strategy from the PMSS event.

The FLEX response timeline has been reviewed and verified to ensure FLEX strategies can be implemented to address the LIP and PMSS impacts through the use of alternate staging areas and pre-deployment of N+1 equipment (Ref. 5).

Development of trigger points for LIP and PMSS pre-deployment of N+1 equipment and documentation of the alternate staging areas are being tracked in the FENOC corrective action program.

The EFWF and auxiliary building which house the FLEX N equipment are not affected by the LIP or PMSS.

## 2. Documentation

2.1 NEI 12-06, Rev. 2, Section G.2 – Characterization of the MSFHI

**Local Intense Precipitation (LIP)**

### Flood Height

The reevaluated LIP analysis, documented in the DB FHRR (Ref. 1), is a short duration low velocity event. The maximum flooding depth of accumulated water in the power block area is 0.5 ft.

### Flood Event Duration

As described in Section 5 of the FHRR (Ref. 1) and page 2 of the RAI response (Ref. 3) the LIP does not affect safety-related equipment. Total event duration is 2.5 hours in the power block area with water level above critical door sills (11 doors) for not more than 33 minutes. One turbine building door has water above the sill for 54 minutes, but the potential to affect safety-related equipment is precluded by a curb located in the turbine building. Residual water in low lying non power block areas will exist for an extended period of time.

### Relevant Associated Effects

The impact of the LIP on the FLEX strategies was evaluated in NORM-LP-7221 (Ref. 5). This evaluation determined that there is sufficient margin in the FLEX strategy to delay Phase 1 and Phase 2 FLEX external actions, if needed, until the water level receded below critical door sill levels. It also determined that due to the shallow depths of the flood and the low velocities of the flood water, Phase 1 and Phase 2 external activities could be completed if necessary. The evaluation identified that the N+1 equipment deployment path and Phase 3 NSRC staging area were affected by the LIP. Both the staging area and the N+1 deployment path are subject to LIP flooding and residual water in low lying areas for an extended period of time.

Additional engineering evaluations were performed to determine the flood duration and identify alternate viable staging areas (Ref. 5). Two viable staging areas were identified. A trigger point for a LIP event will be developed to allow pre-deployment of N+1 equipment. These changes will allow successful implementation of the FLEX strategies as designed.

### Warning Time

A LIP event resulting from a synoptic storm (i.e. large frontal system) provides limited warning time. Based on existing DB site procedures and the MSFHI evaluation performed in NORM-LP-7221 (Ref. 5), the site has approximately one hour of preparation time. The trigger point to be developed will allow for enough time to pre-deploy the N+1 equipment. The amount of N+1 equipment requiring pre-deployment is limited to a 480 volt generator, cable cart, and two pumps (Ref. 5). In the event pre deployment was unsuccessful, the FLEX N equipment remains available to support FLEX implementation.

***Probable Maximum Storm Surge (PMSS)***

**Flood Height**

The reevaluated PMSS analysis, documented in the DB FHRR (Ref. 1), is a short duration low velocity event in the power block area. PMSS with wave run-up was also analyzed resulting in a .1 ft wave run up. The maximum flooding depth of accumulated water, including wave run-up, in the power block area is 10.8 inches (in) above the power block floor and door sill elevations of 585 ft.

**Flood Event Duration**

As described in Section 5 of the FHRR (Ref. 1) and the RAI response (Ref. 3) the PMSS does not affect safety-related equipment. Total event duration is six hours in the power block area with water level above 585 ft door sill elevation for 2.5 hours.

**Relevant Associated Effects**

The impact of the PMSS on the FLEX strategies was evaluated in NORM-LP-7221 (Ref. 5). This evaluation determined that there is sufficient margin in the FLEX strategy to delay Phase 1 and Phase 2 FLEX external actions, if needed, until the water level receded below critical door sill levels. It also determined that due to the shallow depths of the flood and the low velocities of the flood water Phase 1 and Phase 2 external activities could be completed if necessary. The evaluation identified that the N+1 equipment deployment path and Phase 3 NSRC staging area were affected by the PMSS. Both the staging area and the N+1 deployment path are subject to PMSS flooding and residual water in low lying areas for an extended period of time.

Additional engineering evaluations were performed to determine the flood duration and identify alternate viable staging areas (Ref. 5). Two viable staging areas were identified. A trigger point for the PMSS event will be developed to allow pre-deployment of N+1 equipment. These changes will allow successful implementation of the FLEX strategies as designed

**Warning Time**

The PMSS event takes several hours to develop. Once the probable maximum wind event (PMWE) develops it takes approximately three hours for flooding in low lying areas to develop and six hours to cause flooding above the site grade elevation (584 ft) in the power block area. This allows ample time for site preparations as well as N+1 equipment pre-deployment.

## 2.2 NEI 12-06, Rev. 2, Section G.3 – Comparison of the MSFHI and FLEX DB Flood

*Table 1a – Flood Causing Mechanism A (LIP) or Bounding Set of Parameters*

| | Flood Scenario Parameter - LIP | Plant Design Basis Flood | FLEX Design Basis Flood Hazard | MSFHI | MSFHI Bounded (B) or Not Bounded (NB) |
|---|---|---|---|---|---|
| Flood Level and Associated Effects | 1. Max Stillwater Elevation | 584.5 ft | 584.5 ft | 585.5 ft | NB |
| | 2. Max Wave Run-up Elevation | N/A | N/A | N/A | N/A |
| | 3. Max Hydrodynamic/Debris Loading (psf) | Not discussed in USAR | Not discussed in USAR | See Note 3 | NB |
| | 4. Effects of Sediment Deposition/Erosion | Not discussed in USAR | Not discussed in USAR | See Note 4 | NB |
| | 5. Other associated effects (identify each effect) | N/A | N/A | N/A | N/A |
| | 6. Concurrent Site Conditions | N/A | N/A | N/A | N/A |
| | 7. Effects on Groundwater | 250 psf | 250 psf | See Notes 3 & 7 | B |
| Flood Event Duration | 8. Warning Time (hours) | Varies | Varies | Varies See Note 8 | NB |
| | 9. Period of Site Preparation (hours) | Not discussed in USAR | Not discussed in USAR | 1 | NB |
| | 10. Period of Inundation (hours) | Not discussed in USAR | Not discussed in USAR | 0.5 | NB |
| | 11. Period of Recession (hours) | Not discussed in USAR | Not discussed in USAR | 1 | NB |
| Other | 12. Plant Mode of Operations | Not discussed in USAR | Not discussed in USAR | Mode 1 - 6 | NB |
| | 13. Other Factors | N/A | N/A | N/A | N/A |

| Additional notes, 'N/A' justifications (why a particular parameter is judged not to affect the site), and explanations regarding the bounded/non-bounded determination. |
|---|
| 1.<br>All elevation values will be in the Site Datum, IGLD55, unless noted otherwise as the MSFHI value is above design basis it is considered not bounded (NB).<br>References: C-CSS-020.13-014 Rev 1, FHRR Section 3.8 & FHRR Table 1, FHRR Section 2.1.1, USAR Section 2.4.2.3 |
| 2.<br>There is no wave run-up associated with the LIP. The event has a short duration and the standing water recedes quickly. The USAR did not address flooding from the LIP, specifically with regard to standing water, so no wave run-up discussion exists. Since neither the design basis nor the MSFHI identified this as an issue, these values are marked N/A.<br>References: USAR Chapter 2, FHRR |

3.

Debris was accounted for in the LIP model by assuming 55% blockage of the spaces between the vehicle barrier system (VBS) concrete blocks. This blockage has the effect of increasing the water retention time around the power block. The hydrodynamic effects on the VBS are minimal since there still are sufficient flow paths to prevent excessive hydrodynamic and hydrostatic loading. The VBS is a security feature, not a flood barrier. Based on the lack of free debris in the surrounding area there is no loading expected from debris. Building loads identified in calculation C-CSS-020.013-014 Rev. 1 are as follows:

Table 5.0.2 - Maximum Loads on Buildings

| | Building | Max Velocity* (fps) | Max Depth* (ft) | Max Hydrostatic Load (psf) | Max Hydrodynamic Load (psf) |
|---|---|---|---|---|---|
| | Containment Structure | 3.87 | 1.30 | 81 | 29 |
| | Auxiliary Building | 2.46 | 1.23 | 77 | 12 |
| | Turbine Building | 2.31 | 1.02 | 64 | 10 |
| | Personnel Shop | 2.04 | 0.90 | 56 | 8 |
| | LL Radwaste Storage | 1.47 | 0.76 | 47 | 4 |
| | Containment Access | 1.84 | 0.53 | 33 | 7 |
| | Water Treatment Building | 6.14 | 1.30 | 81 | 73 |
| | Intake Structure | 5.48 | 0.39 | 24 | 58 |
| | Diesel Generator Building | 2.82 | 1.55 | 97 | 15 |

*The maximum flood velocity and water depth around each building is used for load computation.

Based on the short duration and small localized loads there is no effect on the structures as a result of a LIP event. These structures are either Category 1 or Category 2 and are evaluated for more significant loads than those presented by the LIP. Per the Design Criteria Manual, all walls for Category 1 seismic structures and Category 2 non seismic structures are designed with hydrostatic and hydrodynamic loads up to the 584 ft level. These loads include soil and water loads. Seismic Category 1 structures are evaluated with loads applied in conjunction with the seismic loads. These

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| loads are significantly greater than the loads from the LIP event; therefore no adverse consequences result from the LIP.<br>Since the design basis does not discuss this issue and the MSFHI does, it is considered not bounded (NB).<br>References: C-CSS-020.13-014 Rev 1, Design Criteria Manual Section II.G.2, USAR Chapter 2 & 3.4 |
| 4.<br>Davis-Besse is located on flat terrain. The average velocity of the flood waters at the peak of the LIP is 4.3 fps in the vicinity of the power block. Very little debris or sediment will be deposited based on the short duration of the event and the impermeable material surrounding the power block area, preventing debris and sediment being entrained in flood waters. This area is concrete or macadam. This hard material will also prevent scour, so it is not considered an issue. Since the design basis does not discuss this issue and the MSFHI does, it is considered not bounded (NB).<br>References: C-CSS-020.13-014 Rev 1, USAR Chapter 2 |
| 5.<br>No additional detrimental effects were identified. Since neither the design basis nor the MSFHI identified any other significant detrimental effects, these values are marked N/A.<br>References: USAR Chapter 2, FHRR |
| 6.<br>No specific additional effects have been identified during a LIP event. It is reasonable to assume there will be winds associated with the storm. However, the rain duration of the LIP event is only 60 mins. The power block internal areas are not flooded as a result of the LIP. Since neither the design basis nor the MSFHI identified this as an issue, these values are marked N/A.<br>References: USAR Chapter 2, FHRR, FIP |
| 7.<br>There will be no adverse groundwater surcharge effects. The short duration of inundation and impermeable materials surrounding the power block area would prevent any change in the groundwater. Critical structures are rated for an additional 250 psf surcharge loading. This item is considered bounded (B) by the existing design basis.<br>References: C-CSS-020.13-014 Rev 1, Design Criteria Manual Section II.G.2 |
| 8.<br>No specific warning time is identified. As outlined in the RAI response discussing the interim actions, site procedures will provide guidance in the event of severe weather. These actions commence based on weather reports or on external agency contacting the control room with notification of impending severe weather. The shift manager then directs actions based on the environmental threat. Based on the run-up of the flood levels associated with a LIP, there is adequate time for the site to respond by shutting doors, hatches and other actions needed to preclude flooding of vital areas. Since the design basis does not discuss this issue and the MSFHI does, it is considered not bounded (NB).<br>References: C-CSS-020.13-014 Rev 1, FHRR Section 5, RAI Response to Interim Actions, RA-EP-02830 Flooding, RA-EP-02810 Tornado or High Winds, RA-EP-02870 Station Isolation, USAR Chapter 2 |

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| 9.<br>As discussed in Item 8 there is no specified warning time. However, as can be seen in the various hydrographs in Attachment 17 of Calc C-CSS-020.13-014 Rev. 1, flooding above grade from LIP takes approximately 51 minutes to affect the critical doors. This allows the onsite personnel sufficient time to ensure doors, hatches etc. to be closed to prevent water ingress. As stated in the FHRR and subsequent RAI associated with Interim actions, it has been determined that these actions are sufficient to protect safety-related equipment. One door does flood prior to 51 minutes, Door 334. This door opens into the turbine building and water rises above the floor elevation at approximately 21 minutes. As discussed in Section 5 of the FHRR, there is a curb that protects safety-related equipment below 585 ft if water were to enter this door. As can be seen by the hydrograph, the actual depth of the water is 6.1 in, which is below the flood height protection provided by the curb (8 in per Drawing A-0005). There are many drainage paths to the lower elevations and the volume is sufficient to preclude flooding of safety-related equipment. This door is closed as part of site response to increasing water levels. Since the design basis does not discuss this issue and the MSFHI does, it is considered not bounded (NB).<br>Calculation C-CSS-020.13-014 Rev. 2, which used refined methodology, reduced the water levels to a 585 ft elevation, which is the door sill height, for all critical doors except for Door 334 discussed above and determined to not be an impact. Three additional doors to the water treatment building are subject to minor flooding and have no impact on safety-related equipment.<br>References: C-CSS-020.13-014 Rev 1 Attachment 17, USAR Chapter 2, FIP, FHRR Section 5, RAI Response to Interim Actions, USAR Chapter 2. |
| 10.<br>The total site inundation period in the power block area is 0.5 hours with only short durations of time above the sills for critical doors. Since the design basis does not discuss this issue and the MSFHI does, it is considered not bounded (NB).<br>Calculation C-CSS-020.13-014 Rev. 2, which used refined methodology, reduced the water levels to a 585 ft. elevation, which is the door sill height, for all critical doors except for Door 334 discussed above and determined to not be an impact. Three additional doors to the water treatment building are subject to minor flooding and have no impact on safety-related equipment.<br>Ref. C-CSS-020.13-014 Rev. 1 Attachment 17, USAR Chapter 2, FIP, FHRR Section 5, RAI Response to Interim Actions, USAR Chapter 2 |
| 11.<br>The site remains accessible during the LIP. As shown in Figure 4.7.3 of calculation C-CSS-020.13-014 Rev. 1, access roads will have varying depths of water. There are several different access points to the site. The low lying areas will have ponding but will not prevent site access. The LIP is of short duration, has relatively shallow depths and has low water velocity. Since the design basis does not discuss this issue and the MSFHI does, it is considered not bounded (NB).<br>References: C-CSS-020.13-014 Rev. 1 Attachment 17, USAR Chapter 2, FIP, FHRR Section 5, RAI Response to Interim Actions, USAR Chapter 2 |
| 12.<br>Plant modes are not discussed in the USAR related to flooding events. The USAR did not identify any flooding impacts to the power block or safety-related equipment. The FLEX strategy does identify different responses based on plant mode and the availability of steam generators for heat transfer. Since the design basis does not discuss this issue and the MSFHI does, it is considered not bounded (NB).<br>References: USAR Chapter 2, FIP, RAI Response to Interim Actions |

13.
No additional factors were identified associated with the LIP. The event is short duration and has low water velocity, so waterborne projectiles are not expected. Since neither the design basis nor the MSFHI identified this an issue, these values are marked N/A.
References: USAR Chapter 2, FHRR

*Table 1b – Flood Causing Mechanism A (PMSS) or Bounding Set of Parameters*

| Flood Scenario Parameter PMSS | | Plant Design Basis Flood | FLEX Design Basis Flood Hazard | MSFHI | MSFHI Bounded (B) or Not Bounded (NB) |
|---|---|---|---|---|---|
| Flood Level and Associated Effects | 1. Max Stillwater Elevation | 583.7 ft | 583.7 ft | 585.81 ft | NB |
| | 2. Max Wave Run-up Elevation | 590.3 ft | 583.7 ft | 589.88 ft | B |
| | 3. Max Hydrodynamic/Debris Loading (psf) | Not discussed in USAR | Not discussed in USAR | See Note 3 | NB |
| | 4. Effects of Sediment Deposition/Erosion | Not discussed in USAR | Not discussed in USAR | See Note 4 | NB |
| | 5. Other associated effects (identify each effect) | N/A | N/A | N/A | N/A |
| | 6. Concurrent Site Conditions | 590.3 ft | 585 ft | 585.9 ft | NB |
| | 7. Effects on Groundwater | 250 psf | 250 psf | See Note 7 | B |
| Flood Event Duration | 8. Warning Time (hours) | Varies | Varies | See Note 8 | NB |
| | 9. Period of Site Preparation (hours) | Not discussed in USAR | Not discussed in USAR | See Note 9 | NB |
| | 10. Period of Inundation (hours) | Not discussed in USAR | Not discussed in USAR | 2.5 in the power block area | NB |
| | 11. Period of Recession (hours) | Not discussed in USAR | Not discussed in USAR | See Note 11 | NB |
| Other | 12. Plant Mode of Operations | Not discussed in USAR | Not discussed in USAR | Mode 1 - 6 | NB |
| | 13. Other Factors | N/A | N/A | N/A | N/A |

| Additional notes, 'N/A' justifications (why a particular parameter is judged not to affect the site), and explanations regarding the bounded/non-bounded determination |
|---|
| 1.<br>All elevation values will be in the Site Datum, IGLD55, unless noted otherwise. Since the MSFHI value is above the design basis, it is considered not bounded (NB).<br>References: C-CSS-020.13-017 Rev. 0, C-CSS-020.13-022 Rev. 0, FHRR Sections 2.1.4 ,2.1.8 & 3.7.4, USAR Section 2.4.2.2.1 |
| 2.<br>Wave run up is discussed in Note 6 as it relates to storm surge in power block area. Since the MSFHI value is below the design basis, it is considered bounded (B).<br>Reference: FHRR Sections 2.1.4 & 2.1.8 |
| 3.<br>No specific debris loading was provided in the storm surge calculations related to the effects on power block structures. However, the storm surge water depth is only slightly greater than the LIP water depth, and the water velocities are significantly less. As shown in the LIP table, the safety-related structures have significant margins related to the effects from flooding. Therefore, no detrimental effects are expected from the PMSS (See Note 7). No specific debris loading was accounted for in the PMSS model. The site is flat terrain and surrounded by marsh land. No significant debris is expected to be transported to the power block area based on the low velocities of the PMSS event and the multitude of obstacles, i.e. fence lines, around the power block area preventing debris transport. Calculation C-CSS-020.13-017 Rev. 0 assumptions state that the VBS could be affected during the storm surge event in that some of the blocks could be dislodged. The effect of any dislodged barriers is assumed to be minimal since barrier overtopping is the flooding mechanism. The VBS is a security feature, not a design flood barrier.<br>Since the design basis does not discuss this issue and the MSFHI does, it is considered not bounded (NB).<br>References: C-CSS-020.13-022 Rev. 0, FHRR Section 3.7.4, C-CSS-020.13-017 Rev. 0 |
| 4.<br>Davis-Besse is located on flat terrain. The USAR does not discuss flooding in the power block area and therefore velocity and scour were not addressed. The PMSS is a short duration and low velocity event (see Note 7). The power block and surrounding area are mostly macadam and concrete. Based on these hard materials, short duration and low water velocities, scour is not an issue. These same parameters minimize soil deposition in the power block area. Since the design basis does not discuss this issue and the MSFHI does, it is considered not bounded (NB).<br>References: C-CSS-020.13-017 Rev. 0 |
| 5.<br>No additional detrimental effects were identified.<br>Since neither the design basis nor the MSFHI identified this as an issue, these values are marked N/A.<br>Reference: C-CSS-020.13-022 Rev. 0, FHRR Section 3.7.4, C-CSS-020.13-017 Rev. 0. |
| 6. *Discuss conditions that could exist concurrent with this flood-causing mechanism or combined-effect flood (e.g. high winds, ice formation, etc.)*<br>The specific additional effect identified during a PMSS event is the PMWE, which is required to generate the PMSS. The power block area is flooded as a result of the PMSS. Wave run-up values associated with the PMSS increase the flood height around the power block by 0.1 ft due to wind. This increases the standing water elevation from 585.81 ft to 585.9 ft. The PMSS is a short duration event, and the standing water in the power block area recedes in approximately 2.5 hours. The new hazard remains bounded with regard to the storm surge impact on the earthen berms. The design value for these berms |

is 590.3 ft and the MSFHI value is 589.88 ft. The USAR does not specifically address flooding from the PMSS with regard to standing water and wave run up effects in the power block area. Since the design basis does not discuss this issue and the MSFHI does, it is considered not bounded (NB).
Calculation C-CSS-020.13-017 Rev. 1 used a refined analysis to evaluate the PMSS event, which resulted in no flooding in the power block area.
References: C-CSS-020.13-022 Rev. 0, FHRR Section 3.7.4, C-CSS-020.13-017 Rev. 0

7.
There will be no groundwater surcharge effects. The short duration of inundation, approximately 2.5 hours, and impermeable materials surrounding the power block area would prevent any change in the groundwater. The power block structures are designed for groundwater levels up to 584 ft. The auxiliary building, containment structure and turbine building design includes a 250 psf surcharge load. The intake structure has 500 psf surcharge load in its design. These structures are either Category 1 or Category 2 and are evaluated for more significant loads than those presented by the PMSS. Per the Design Criteria Manual, all walls for Category 1 seismic structures and Category 2 non seismic structures are designed with hydrostatic and hydrodynamic loads up to the 584 ft level. These loads include soil and water loads. Seismic Category 1 structures are evaluated with loads applied in conjunction with the seismic loads. These loads are significantly greater than the loads from the PMSS event; therefore no adverse consequences result from the PMSS. The hydrostatic loading from the PMSS is as follows:

| Maximum Loads on Buildings | | | | | |
|---|---|---|---|---|---|
| Observation Site | Nearest Buildings | Max Velocity (fps) | Max Flow Depth (ft) | Max Hydrostatic Load (psf) | Max Hydrodynamic Load (psf) |
| C4 | Aux Building North | 0.4 | 2.45 | 152.88 | 0.31 |
| C13 | Containment Structure | 0.3 | 2.03 | 126.67 | 0.17 |
| C14 | Aux Building West | 0.6 | 1.18 | 73.632 | 0.69 |
| C20 | Intake Structure/Turbine | 1.1 | 2.08 | 129.79 | 2.34 |
| C22 | Turbine Building | 1.1 | 2.40 | 149.76 | 2.34 |

If the hydrostatic load were directly applied to the wall as a groundwater surcharge load, the structure designs have sufficient margins to preclude any adverse effects. Also, the groundwater study performed in 2007 indicates that groundwater tends to flow away from the power block area rather than accumulating against the power block sub grade walls. This would reduce any surcharge. Since the design basis does discuss this issue, it is considered bounded (B).
Calculation C-CSS-020.13-017 Rev. 1 used a refined analysis to evaluate the PMSS event, which resulted in no flooding in the power block area.
References: C-CSS-020.013-017 Rev. 0, Groundwater study, Design Criteria Manual Section II.G.2.6

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| 8.<br>No specific warning time is identified.  As outlined in the RAI response discussing interim actions, site procedures will provide guidance in the event of severe weather.  These actions commence based on weather reports or an external agency contacting the control room with notification of impending severe weather.  The shift manager then directs actions based on the environmental threat.  Review of the data presented in calculation C-CSS-020.03-017 Rev. 0 indicates the actual storm surge takes hours to develop.  The shortest time shown for the onset of site flooding is six hours.  The PMSS development requires high winds to occur.  Based on the length of time required and the high wind condition needed as well as the antecedent lake level required the site would have entered the Tornado and High Winds and the Station Flooding procedures.  The site would have ample warning time to prepare by shutting doors, hatches, and other actions to preclude flooding of vital areas.  Additionally, the Emergency Response Organization (ERO) would be staffed if these conditions were to occur, providing additional staff as needed.  Since the design basis does not discuss this issue and the MSFHI does, it is considered not bounded (NB).<br>References: C-CSS-020.013-017 Rev. 0, FHRR, USAR Chapter 2, RAI Response, RA-EP-0283 Flooding, RA-EP-02870 Station Isolation, RA-EP-02810 Tornado or High Winds |
| 9.<br>As discussed in Item 8 there is no specified warning time.  However, as can be seen in the various hydrographs and ENERCON Report FNOCDB101-PR-001, the buildup for the PMSS takes several hours.  The shortest time identified for the onset of flooding in low lying site areas is three hours.  Areas closer to the power block do not begin to flood until six hours after the beginning of the storm.  This allows the onsite personnel sufficient time to ensure doors, hatches etc. to be closed to prevent water ingress.  As stated in the FHRR and subsequent RAI associated with interim actions, procedural actions are sufficient to protect safety-related equipment.<br>Since the design basis does not discuss this issue and the MSFHI does, it is considered not bounded (NB).  Calculation C-CSS-020.13-017 Rev. 1 used a refined analysis to evaluate the PMSS event, which resulted in no flooding in the power block area.<br>References: C-CSS-020.013-017 Rev. 0, FHRR, USAR Chapter 2, ENERCON Report FNOCDB101-PR-001, RAI Response, RA-EP-0283 Flooding, RA-EP-02870 Station Isolation, RA-EP-02810 Tornado or High Winds. |
| 10.<br>Areas around the power block begin to flood at T+6 hours with water rising above site grade of 584 ft.  Water continues to rise for approximately two hours and then begins to recede.  Water will recede below 584 ft by T+12 hours for a total duration above 584 ft of six hours.  Critical doors and openings are located at the 585 ft elevation.  The period of inundation above 585 ft is approximately 2.5 hours in the power block area.<br>Staging Area B is flooded, precluding the receipt of NSRC equipment to support Phase 3 activities.  The designated staging area, Staging Area B, and the associated haul path are inundated for approximately 44 hours.  Flooding begins at T+3 hours, peaks by T+8 hours and slowly recedes.  The storm surge will also impact the site access via the roadways.  As discussed in Note 11, some of the site access roads are flooded for 14 hours.  Alternates staging areas have been evaluated in ENERCON Report FNOCDB101-PR-001. These alternate areas are dry or have minimal flooding and will be available during a PMSS event.  As discussed in Note 8 the site would prepare for the potential inundation and roadway flooding through execution of the EP procedures up to and including the station isolation procedure.  As the sites access becomes threatened the ERO will mobilize and additional site personnel will be designated to support the station.<br>Since the design basis does not discuss this issue and the MSFHI does, it is considered not bounded (NB).  Calculation C-CSS-020.13-017 Rev. 1 used a refined analysis to evaluate the PMSS event, which resulted in no flooding in the power block area. |

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| References: C-CSS-020.013-017 Rev. 0, FHRR, USAR Chapter 2, ENERCON Report FNOCDB101-PR-001, RAI Response, RA-EP-0283 Flooding, RA-EP-02870 Station Isolation, RA-EP-02810 Tornado or High Winds |
| 11.<br>The PMSS in the power block is above the 585 ft elevation for 2.5 hours. The flooded areas around the site, including the access roads, remain flooded for a significantly longer period. As discussed above, Staging area B is flooded in excess of 44 hours as it is a low spot on the site. The north access road begins to flood at T+3 hours, peaks at T+5 hours, and is flooded for 14 hours. Several other roadways are also flooded for a significant period. The PMSS calculations did not evaluate roadways external to the site. As discussed in Note 10, the site has a station isolation procedure that addresses actions in the event a flood would prevent site access. ENERCON Report FNOCDB101-PR estimates the flood waters receding from the low spots on site within 44 hours of the onset of flooding, but based on topography and natural drainage of Staging Area B, its availability is indeterminate. Alternate staging areas are available as discussed in Note 10. Existing ERO processes recognize the need to be able to support the sites needs in the event of a station isolation event, including delivery of additional personnel and supplies. As discussed in the station flooding procedure, higher elevation roadways are designated as the most likely to clear first in the event of flooding, based on their elevations.<br>Since the design basis does not discuss this issue and the MSFHI does, it is considered not bounded (NB).<br>References: ENERCON Report FNOCDB101-PR-001, C-CSS-020.13-017 Rev. 0, RAI Response, RA-EP-0283 Flooding, RA-EP-02870 Station Isolation, RA-EP-02810 Tornado or High Winds |
| 12.<br>Plant modes are not discussed in the USAR related to flooding events. The FLEX strategy does identify different responses based on plant mode and the availability of steam generators for heat transfer.<br>Since the design basis does not discuss this issue and the MSFHI does, it is considered not bounded (NB).<br>References: FIP, USAR Chapter 2 |
| 13.<br>No additional factors were identified associated with the PMSS. The flooding in the power block area has a short duration and low water velocity, so waterborne projectiles are not expected. Since neither the design basis nor the MSFHI identified this as an issue, these values are marked N/A.<br>References: FHRR, FIP, USAR Chapter 2 |

## 2.3. NEI 12-06, Rev. 2, Section G.4 – Evaluation of Mitigating Strategies for the MSFHI

### 2.3.1 NEI 12-06, Rev. 2, Section G.4.1 – Assessment of Current FLEX Strategies

The overall plant response strategies to an ELAP and loss of ultimate heat sink event can be implemented as described in the Final Implementation Plan using the current FLEX procedures, equipment and personnel, provided the following modifications are implemented:

a. Trigger points established to allow for pre-deployment of N+1 equipment.
b. Utilization of alternate NSRC staging areas, if required.

#### 2.3.1.1 Conclusion – Modify FLEX Strategy.

### 2.3.2 NEI 12-06, Rev. 2, Section G.4.2 – Assessment for Modifying FLEX Strategies:

The existing FLEX mitigation strategies can be implemented with relatively minor modifications.

The MSFHI LIP event produces rainfall amounts that challenge the current FLEX mitigation strategies. LIP water levels flood the N+1 equipment deployment path, and it remains flooded for an extended period of time. The LIP also floods the designated site staging area for NSRC equipment receipt affecting Phase 3 activities.

Alternate staging areas have been identified and verified to be available during a LIP event to support receipt of NSRC equipment. A trigger point will be developed to allow for pre-deployment of N+1 equipment prior to flooding of the deployment path.

The current mitigation strategy timeline contains sufficient margin for local floodwaters to recede prior to the required FLEX N actions or equipment deployment as described in the FIP for FLEX Phase 1 and Phase 2 actions. The use of alternate staging areas is also an option that is currently addressed in the SAFER Playbook, which would allow for completion of FLEX Phase 3 actions.

The MSFHI PMSS causes flooding of the NSRC staging area at the site precluding its use. The PMSS also floods the N+1 equipment deployment path. The flooding of this path does not occur until three hours into the event allowing sufficient time for the pre-deployment of N+1 equipment.

Alternate staging areas have been identified and verified to be available during a PMSS event to support receipt of NSRC equipment. A trigger point will be developed to allow for pre-deployment of N+1 equipment prior to flooding of the deployment path.

The current mitigation strategy timeline contains sufficient margins and diversity to allow successful implementation of the FLEX strategy using FLEX N equipment for Phase 1 and Phase 2 actions, as well as the versatility to use the alternate staging areas to support Phase 3 activities.

No revalidation is required as these changes do not affect the FLEX strategy implementation timelines.

## 2.4. References


1. FHRR Rev 1 – ML14070A108 - Letter FENOC to NRC – Dated 3/11/2014, L-14-04, FirstEnergy Nuclear Operating Company (FENOC) Response to NRC Request for Information Pursuant to 10 CFR 50.54(f), Regarding the Flooding Aspects of Recommendation 2.1 of the Near Term Task Force (NTTF) Review of Insights from the Fukushima Dai-ichi Accident
2. FHRR Rev 2 – ML15750A023 – Letter FENOC to NRC – Dated 2/25/2015, L-15-043, Revision to Flood Hazard Reevaluation Report in Response to Near Term Task Force Recommendation 2.1 (TAC No. MF3721)
3. RAI response – ML14198A400 – Letter FENOC to NRC- Dated 7/17/2014, L-14-235, Supplement to Flood Hazard Reevaluations Report in Response to Near Term Task Force Recommendation 2.1
4. Staff Assessment – ML 15239B212 - Letter NRC to FENOC – Dated 9/3/2015, Davis-Besse Nuclear Power Station, Unit 1- Interim Staff Response To Reevaluated Flood Hazards Submitted In Response To 10CFR50.54(f) Information Request- Flood Causing Mechanism Reevaluation (TAC NO. MF3721)
5. NORM-LP-7221, Davis-Besse Flooding Mitigating Strategy Assessment Support Document